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BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

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Most Critical Testing Still Lies Ahead For Missiles In Theater Nuclear Modernization.

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The chairman of the Subcommittee on Europe and the Middle East, House Committee on Foreign Affairs, asked GAO to study certain aspects of the program to modernize theater nuclear weapons intended for deployment in several European countries.

Pershing II's testing so far has produced encouraging results, but most of the critical hardware tests are still to be accomplished in a schedule which has been compressed to meet NATO deployment commitments. Several of the Ground Launched Cruise Missile's technical problems remain to be resolved and have delayed the start of its operational tests and subsequent production. Nevertheless, the date it is scheduled to begin deployment remains unchanged.

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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To the President of the Senate and the
Speaker of the House of Representatives

This report presents ~~our views on~~ some of the implications of the decision by the North Atlantic Treaty Organization to modernize its theater nuclear forces. It also covers the progress being made in developing Pershing II and the Ground Launched Cruise Missile for eventual deployment in Europe.

We are sending copies of this report to the Secretary of State; the Secretary of Defense; and the Director, Office of Management and Budget.

James B. Stuck
Comptroller General
of the United States

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COMPTROLLER GENERAL'S REPORT
TO THE CONGRESS

MOST CRITICAL TESTING STILL
LIES AHEAD FOR MISSILES
IN THEATER NUCLEAR
MODERNIZATION PROGRAM

D I G E S T

The Department of Defense is developing two missiles, the Army's Pershing II and the Air Force's Ground Launched Cruise Missile, as part of a program to modernize its theater nuclear forces in Europe. The two weapons are to provide the North Atlantic Treaty Organization (NATO) with a capability to launch land-based theater nuclear missiles from Western Europe that can strike targets within the Soviet Union. Deployed theater nuclear missiles cannot reach beyond the Soviet satellite countries of the Warsaw Pact.

RATIONALE FOR MODERNIZING
THEATER NUCLEAR FORCES

Modernizing theater nuclear weapons was spurred, not only by the Soviet deployment of the Backfire bomber and the SS-20 ballistic missile, but also by the emergence of Soviet parity with the United States in strategic nuclear systems. This has increased NATO's concern that the Soviet Union could mistakenly come to believe it could use its long-range theater nuclear weapons to strike NATO targets without drawing a strategic retaliatory response from the West. The modernizing of theater nuclear forces is intended to provide NATO with a more flexible response to any Soviet initiative in that it will add a credible theater nuclear capability to NATO's other options.

In a December 1979 meeting, NATO ministers decided that the Ground-Launched Cruise Missiles would be deployed on the territories of the Federal Republic of Germany, the United Kingdom, Italy, Belgium, and the Netherlands, and that the Pershing IIs would replace the Pershing Ia's in the Federal Republic of Germany. (See pp. 1 to 3.)

POLITICAL ASPECTS OF DEPLOYMENT

The participating NATO ministers unanimously agreed to continue arms control efforts simultaneously with the planned modernizing and deployment of the theater nuclear weapons, with the belief that combining the two would best meet NATO's security needs. Accordingly, the December 1979 decision explicitly provided for a parallel approach linking both efforts, modernizing, and arms control. Preliminary exchanges on arms control between the United States and the Soviet Union were held from October 17, to November 17, 1980, in Geneva. These provided an opportunity for both sides to clarify their positions and better define the scope of future negotiations. The exchanges are to resume in 1981.

The United Kingdom, the Federal Republic of Germany, and Italy are implementing the plan. Belgium and the Netherlands initially expressed reservations about deployment in their own countries. A Belgian cabinet decision of September 19, 1980, indicates that the Belgian Government would agree to participate proportionately in the eventual NATO deployment. The final total of missiles to be deployed may be affected by progress made in the arms control talks. GAO, however, has not independently confirmed Belgium's position. The Netherlands plans to wait until late 1981 before making a commitment on deployment. (See p. 3.)

MODERNIZING OBJECTIVES

The new weapons are not only to provide increased range over the current land-based theater nuclear missiles, but are also expected to be more accurate and more survivable. Both Pershing II and the Ground Launched Cruise Missile are to be armed with warheads that would inflict only minimal collateral damage around the target area. Testing to date has been too limited to provide an absolute indication that either missile will achieve all these objectives. (See pp. 8 to 10 and 16 and 17.)

RESULTS OF PERSHING II'S INITIAL TESTS

Tests to demonstrate Pershing II's range will not begin until April 1982 when the Army plans to conduct the first of 28 scheduled missile firings. The Army is satisfied that several critical test objectives were met in five firings during advanced development, although only one achieved the desired accuracy. Nevertheless, this one successful firing is encouraging because it demonstrated the feasibility of achieving the specified accuracy. Pershing II's new guidance concept, however, which employs a new terminal guided reentry vehicle and is the heart of the system, has yet to be observed in the critical operational testing of the full system. (See pp. 8 and 9.)

CONCURRENCY IN PERSHING II PROGRAM

After the start of the program, a Secretary of Defense decision advanced Pershing II's originally planned deployment date by 16 months--recently adjusted to 12 months. This decision was made in anticipation of the NATO ministers' agreement, and to bring Pershing II's deployment more in line with that of the Ground Launched Cruise Missile. Consequently, the Pershing II program now has a high degree of concurrency; that is, its development will continue well after the initial production decision is made. Normally, production contracts are awarded shortly after a favorable production decision. The Pershing II production decision is due after only the first two missiles have been test fired, and long before engineering development has been completed. The Army believes that technical problems which remain are not high risk and is confident that Pershing II can adhere to its schedule. (See pp. 4, 5, 8, 11, and 12.)

CRUISE MISSILE TESTING AND SCHEDULE CONCERNS

The Ground Launched Cruise Missile has considerable similarity with two other cruise missiles in development, one air launched and one sea launched. Therefore, the Air Force will evaluate the Ground Launched Cruise Missile's progress not only on the basis of

its own showing in testing, but also on the basis of the test results of the other two missiles.

To date, there have been no Government flight tests of the Ground Launched Cruise Missile. Operational tests of the air launched missile, still in progress, have revealed some serious problems relating to its (1) ability to maintain flight levels that would minimize radar detection, (2) terrain contour mapping guidance, and (3) reliability. The same problems are presumed to apply to the other two missiles. (See pp. 13 to 16.)

There has been a recent substantial slip in the Ground Launched Cruise Missile test schedule due to problems with developing the software. Although the start of operational testing and the scheduled production decision have both slipped, the initial operational capability date remains firm. With this change, the time available from the start of the missile's production until its scheduled initial deployment has been cut in half.

Regardless of these slippages and other uncertainties remaining in the development of both Pershing II and the Ground Launched Cruise Missile, the Departments of State and Defense have reiterated that the United States intends to deploy the missiles on time, according to the NATO decision. Both Departments acknowledge that missiles initially deployed may require some subsequent modification or correction, but consider it of overriding importance for the United States to meet its commitment to have the missiles in place, as scheduled, even if they fall somewhat short of meeting all their performance requirements. (See pp. 13 and 14.)

CONCLUSIONS

The Army's schedule for developing and producing the initial quantities of Pershing II missiles must be viewed as containing a high degree of concurrency. It is not unusual to find some concurrency in major weapon system programs, particularly, where an

urgent need to deploy the system exists. However, programs with as much concurrency as is present in Pershing II generally require more time than is budgeted for proving their performance and reliability before they enter production.

While considerable subsystem and component testing has not surfaced any significant problems with Pershing II, experience with other weapon systems has shown that integrated testing of the entire system often brings out shortcomings which could not be foreseen when the components were tested by themselves. The limited number of live firings held so far do not appear sufficient to indicate whether the system will be able to meet all its performance objectives by the scheduled initial deployment date.

As with Pershing II, the Ground Launched Cruise Missile still contains many critical unknown factors. The heart of the system, its terrain-following guidance, must still be demonstrated in a realistic operational environment. The Air Launched Cruise Missile test results, as they apply to the ground launched missile, are cause for concern and indicate that considerable progress must still be made in perfecting the cruise missile to achieve the desired capability and reliability.

The recent slip in the cruise missile's test schedule raises further concerns about the program. The severity of the problems and how quickly they can be resolved will determine whether the Air Force can begin the initial deployment schedule with a fully operational system.

Due to the understandable importance placed on meeting the deployment commitments, there is obviously added pressure to resolve remaining critical performance deficiencies before they are to begin deployment. To become involved in modifications after deployment could result in considerable cost. Defense is confident the missiles will meet their performance objectives. However, the two programs bear close

watching to assure that they perform satisfactorily before beginning deployment.

RECOMMENDATION

The successful deployment of Pershing II and the Ground Launched Cruise Missile greatly concerns the Congress, particularly, the Committees on Appropriations and Armed Services and the Committees which deal with foreign affairs. GAO, therefore, recommends that the Secretaries of State and Defense include in their annual presentations before the appropriate committees, and more frequently if critical events occur, details on the progress made towards modernizing and deployment of the theater nuclear weapons in the context of the December 12, 1979, NATO decision.

AGENCY COMMENTS

In discussions with the Department of Defense officials associated with the management of the Pershing II and Ground Launched Cruise Missile programs and with officials of the Department of State's Bureau of Political-Military Affairs, they stated that they agreed with GAO's recommendation.

However, in both their oral and written comments, the Department of State said the report did not sufficiently emphasize the importance of the unanimous decision by the NATO ministers to modernize the theater nuclear forces after a prolonged effort to secure such agreement. The Department of State believes this decision, and the resolve to press ahead with modernizing, were responsible for bringing the Soviets to the negotiating table at Geneva. State Department officials are satisfied that good progress is being made in the three countries--the United Kingdom, the Federal Republic of Germany, and Italy--that have already begun to implement the NATO ministerial decision.

In its written comments, the Department of Defense does not agree that the degree of concurrency in the Pershing II program is high. Defense officials believe all critical testing of Pershing II will have

been completed before the production decision. They have stated that program risks will be further reduced by beginning production at a low level until testing is completed. GAO adheres to its position, however, that results available from the active flight tests to be held before the production decision will be too limited to permit a proper assessment of the system's readiness for production.

Defense officials also believe that data provided by large numbers of Sea Launched Cruise Missile flight tests in a configuration closely corresponding to the Ground Launched Cruise Missile will be useful in assessing the latter's capability in all important areas before it is deployed. Defense officials said tests are continuing to address problems of establishing proper flight levels to minimize detection and problems with terrain contour mapping guidance, which were disclosed in earlier tests. (See pp. 20 and 21.)

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ABBREVIATIONS

ALCM	Air Launched Cruise Missile
CEP	circular error probable
GLCM	Ground Launched Cruise Missile
NATO	North Atlantic Treaty Organization
SLCM	Sea Launched Cruise Missile
TERCOM	terrain contour matching

CHAPTER 1

INTRODUCTION

On December 12, 1979, following a meeting in Brussels of foreign and defense ministers of the North Atlantic Treaty Organization (NATO) member governments, it was announced that the ministers had unanimously agreed to the deployment of improved, long-range theater nuclear missiles in several West European countries. There would be 464 Ground Launched Cruise Missiles (GLCMs) and 108 Pershing IIs deployed. The latter was to replace the U.S. Pershing Ia force now in the Federal Republic of Germany. This modernization program is to increase NATO's capability to strike targets in the Soviet Union. They are expected to be much more accurate than existing weapons, to minimize collateral damage, and to be more survivable against attack through greater mobility, increased hardness, and dispersed deployment.

At the same time, the ministers also agreed to begin a parallel effort to bring the GLCMs and Pershing IIs and certain Soviet land-based long-range theater nuclear missiles into arms control discussions between the United States and the Soviet Union. Following the ministers' decision, the United States informed the Soviet Union that it was prepared to begin discussions. The Soviet Union rejected this offer and insisted that NATO first reverse its deployment decision. This was unacceptable to the NATO members, and the Soviet Union subsequently dropped its precondition. Preliminary exchanges on arms control involving theater nuclear weapons occurred between October 17, and November 17, 1980, in Geneva. These provided an opportunity for both sides to clarify their positions and better define the scope of negotiations. The exchanges are to resume in 1981.

The ministers recognized, however, that regardless of the outcome of these arms control talks, it would be necessary to begin redressing the widening gap which they perceived in East-West theater nuclear capability, favoring the Soviets. This gap resulted from the deployment by the Soviets of the SS-20 medium range ballistic missile and the Backfire bomber, and took on added significance in the context of overall strategic parity. Negotiating the weapon reductions on the basis of currently deployed systems would leave the West with a weak, long-range theater nuclear posture and provide little motivation for the Soviet Union to accept appropriate restraints. The modernization program is, therefore, proceeding.

RATIONALE FOR THE DEPLOYMENT DECISION

Significant improvements in the Soviet Union's theater nuclear weapon capability began in 1974 with the deployment of the Backfire bomber. The Backfire has a greater range and is more survivable than the Badger and Blinder aircraft it replaces. Beginning in 1977, the Soviets also deployed the SS-20 missile, considered a more lethal, accurate, and survivable missile than the SS-4s and 5s it is gradually replacing.

The Backfire has a range of up to 4,200 kilometers which would allow it to be based ~~Deleted~~ and still pose a threat throughout NATO. The SS-20 is a mobile system which employs a missile carrying three warheads, each capable of striking a different target. It has a range in excess of 4,400 kilometers which would permit its striking all its targets in NATO and still remain outside the range of NATO's current land-based theater nuclear missiles.

When the United States was ahead of the Soviets in strategic nuclear weapons, its ability to deter nuclear aggression against its NATO allies was less likely to be questioned. Any Soviet initiative against the alliance in Europe could have evoked a response from the United States with strategic nuclear weapons superior to the Soviets. The emergence of Soviet parity with the United States in strategic nuclear systems, however, has raised NATO's concerns that the Soviet Union could mistakenly come to believe it could use or threaten to use its long-range theater nuclear weapons to strike NATO targets without drawing a strategic retaliatory response from the West.

A key to a credible deterrence in NATO is the ability to respond with any one of several options, for example, with conventional weapons, theater nuclear weapons, or strategic nuclear weapons. The strengthening of NATO's theater nuclear forces is intended to provide NATO with a more flexible response to any Soviet initiative in that it will add a credible theater nuclear capability to NATO's other options.

CURRENTLY DEPLOYED NUCLEAR WEAPONS

NATO's current land-based theater nuclear missiles include the U.S. Pershing Ia and nuclear LANCE, neither of which has the range to reach into the Soviet Union. Other weapons like the U.S. F-111 fighter/bomber and the British Vulcan bomber are available for a theater nuclear role, as

are the U.S. Poseidon and British Polaris submarines. All are capable of striking targets in the Soviet Union, but they do not redress NATO's land-based missile deficiency.

MISSILES SELECTED FOR MODERNIZING THE FORCE

The Department of Defense documents state that the land-based Pershing II and GLCM were selected over sea-based alternatives for several reasons. First, they can redress the imbalance in land-based missile systems--the area of NATO's greatest deficiency in theater nuclear capability. Second, land-based missiles allow for a participation by NATO member States in basing and supporting the missile systems, a situation not possible with sea-based systems because it would require stationing foreign personnel aboard U.S. vessels. Finally, the physical location of the land-based systems in the European theater manifests their direct role as a deterrent.

Although Pershing and GLCM are similar in operational concept, Pershing II will be operated by the Army and GLCM by the Air Force. The Pershing II and GLCM systems will be manned by U.S. personnel, although some host nations will contribute some security personnel.

A total of 108 Pershing IIs are to be based in the Federal Republic of Germany while 464 cruise missiles are planned for basing in Great Britain, the Federal Republic of Germany, Italy, Belgium, and the Netherlands. Implementation is going forward in the first three countries. Belgium and the Netherlands have expressed reservations regarding the deployment of cruise missiles in their countries. Both Department of Defense and State officials informed us that a Belgian Cabinet decision of September 19, 1980, indicates that the Belgian Government would agree to participate proportionately in the eventual NATO deployment. However, we have not independently confirmed the implications of this decision. The final total of missiles deployed may be affected by progress made in the arms control talks. The Netherlands plans to wait until late 1981 before making a commitment on deployment.

MISSILE DESCRIPTION AND STATUS

Both the Pershing II and GLCM systems are being designed for high accuracy and survivability. The warheads are to have yields which could permit a minimum of collateral damage. Both missiles are to achieve initial operational capability in December 1983.

Pershing II

Pershing II is an evolutionary modernization of the Pershing Ia surface-to-surface missile system currently fielded in the Federal Republic of Germany. It has evolved into a system having a new terminally guided reentry vehicle with a new airburst/surface burst warhead, and new propulsion and guidance sections.

The Army is looking to the new reentry vehicle guidance to provide greater accuracy by achieving a ~~Deleted~~ circular error probable (CEP) compared to Pershing Ia's ~~Deleted~~ CEP. The ~~Deleted~~ CEP indicates an expectancy that half the Pershings successfully launched will fall within ~~Deleted~~ of the point targeted. This accuracy is to be accomplished through a correlation technique which matches reference scenes of the terrain, stored in the computer, with live returns from the missile's radar during missile reentry. When the correlations are completed and the reentry vehicle's position relative to the target has been determined, an on board computer then provides corrective guidance commands to the reentry vehicle. This process continues until the missile is close to the target.

The reentry vehicle accommodates a surface burst/air burst warhead. The low yield warhead, combined with its greater accuracy, is expected to result in reduced collateral damage and increased effectiveness. The Department of Defense recently decided not to arm Pershing II with an Earth penetrator warhead which was once considered as an alternate warhead.

The new propulsion sections in Pershing II are to provide a missile range of ~~Deleted~~ compared to Pershing Ia's ~~Deleted~~. The missile, thus, would be capable of striking Soviet territory, whereas Pershing Ia cannot strike beyond Soviet satellite countries.

Status

In February 1979 the system was approved for engineering development. A contract was awarded that same month. In August 1979 the Secretary of Defense directed the Army to advance the planned initial deployment by 16 months to August 1983--recently adjusted to December 1983, to coincide with the GLCM system's initial deployment. A production decision is scheduled for June 1982. The decision to advance the deployment date was made in anticipation of the NATO

ministers' agreement, and to bring Pershing II's deployment more in line with GLCM's deployment.

GLCM

GLCM is one of three cruise missile weapon systems being developed. The others are the Air Launched Cruise Missile (ALCM) and the Sea Launched Cruise Missile (SLCM). Until recently, all three were managed by a joint service project office. ALCM was transferred to Air Force management as a result of a Defense Systems Acquisition Review Council recommendation in May 1980.

GLCM, which will be operated by the Air Force, does not replace any existing weapon system. It is a variation of SLCM being developed by the Navy. The ground launcher and control subsystems, for the most part, are unique to GLCM. The primary elements of GLCM are the missile, a transporter-erector-launcher, and a launch control center.

The transporter-erector-launcher consists of a launcher with four missiles mounted on a semitrailer. The launch control center is also mounted on a semitrailer. It houses a crew and various equipment for communications, monitoring the missile's status, and launching the missile. The missile is powered by a jet engine. A solid propellant booster is used to obtain cruise speed.

GLCM is guided by an inertial navigation system and a system of terrain contour matching (TERCOM), for making guidance corrections. Using a radar altimeter to compare the terrain contour with prestored contour data, the missile will correct its course as needed to a preprogrammed target. The radar altimeter measures the missile's altitude above the ground, and the barometric altimeter primarily estimates the altitude of the missile above sea level. The digital computer then subtracts one measurement from the other to determine terrain elevation and compares it to the stored map data. In most cases, a TERCOM area consists of three closely spaced maps. If at least two of the three TERCOM fixes at the update area agree, the computer then gives instructions for course corrections and the missile continues to the next update area and finally to the target where it detonates.

Status

In 1977 the Department of Defense established the Joint Cruise Missile Project Office to develop the three cruise missiles with maximum commonality. GLCM was first funded in October 1977 for system development and integration.

In February 1980 negotiations were concluded on an engineering development contract with General Dynamics Corporation. A decision on full production, originally scheduled for April 1982, has now slipped to May 1983.

HOUSE FOREIGN AFFAIRS COMMITTEE INTEREST

The decision to deploy GLCM and Pershing II was reached after 2 years of discussions among the participants. NATO also supported the U.S. decision to begin negotiations on long-range theater nuclear forces. The critical importance of the deployment decision, and the arms control negotiations that were to follow, prompted the Chairman of the Subcommittee on Europe and the Middle East, House Committee on Foreign Affairs, to request us to study certain aspects of the intended deployment. The subcommittee asked for an assessment of GLCM and Pershing II demonstrated performance capabilities, and the prospects of meeting their scheduled deployment date, which are discussed in this report. Additional matters the chairman asked us to review, which concern the implications of the deployment decision for negotiations on arms control and the balance of forces in Europe, are to be the subject of a report to follow.

OBJECTIVES, SCOPE, AND METHODOLOGY

Our objective was to determine the progress of the two missile programs, particularly, their performance in testing and the significance of the tests still remaining, and use these as the basis for assessing the prospects for the missiles meeting their performance and initial deployment requirements. In reviewing these programs, we also examined some of the implications of the decision by NATO foreign and defense ministers to modernize its theater nuclear forces.

We interviewed personnel in the Departments of Defense and State associated with the December 1979 decision and the management of the Pershing II and GLCM programs. These officials briefed us on the steps leading up to the December 1979 deployment decision and on the status of arms control activities. We reviewed the Army and Air Force missile program test reports and discussed them with the project managers and other Defense officials at Army and Air Force Headquarters, who share responsibility for the programs. The results of the interviews and reviews of the records were combined in what we judge to be an accurate description of the current status of the theater nuclear force modernization program.

We originally intended to include in this report a discussion of the commitments and responsibilities of the NATO members on whose territories the theater nuclear missiles are to be deployed. Our plan was to discuss with European ministry officials actions they were taking to prepare the missile sites and provide for the missiles' security, as well as their perception of the relationship of the modernizing program to arms control talks. In view of certain political decisions that were still to be made in some of the host countries, the Department of State asked us to delay for the future this portion of our work. This was agreed to by the subcommittee chairman.

The records reviewed and the officials interviewed were from the following organizations.

- Office of the Deputy Under Secretary of Defense for Policy Plans, Washington, D.C.
- Office of the Under Secretary of Defense for Research and Engineering, Washington, D.C.
- Office of the Assistant Secretary of Defense for Program Analysis and Evaluation, Washington, D.C.
- Bureau of Political-Military Affairs, Department of State, Washington, D.C.
- Headquarters, Department of the Army, Washington, D.C.
- U.S. Army Missile Command, Redstone Arsenal, Huntsville, Alabama.
- Headquarters, Department of the Air Force, Washington, D.C.
- Defense Nuclear Agency, Washington, D.C.
- Defense Mapping Agency, Washington, D.C.

CHAPTER 2

TESTING HAS BEEN TOO LIMITED TO ASSESS PERSHING II'S PROBABILITY OF MEETING PERFORMANCE GOALS

The Pershing II program will have a high degree of concurrency due to the decision to advance European deployment of the first units by 12 months to December 1983. Pershing II's development will continue for more than a year after the initial production decision is made. The Army has been awarding production contracts for major weapons shortly after a favorable production decision. The schedule now shows the following.

<u>Milestone</u>	<u>Date</u>
Full-production decision	June 1982
Complete engineering development	Sept. 1983
Initial operational capability	Dec. 1983

If the schedule is adhered to, the production decision will come after only 2 of the 28 missile test firings, planned to be conducted during engineering development. Further, engineering development will not have been completed until more than a year after production is to begin.

SPECIFIC AREAS OF IMPROVEMENT SOUGHT

The modernizing program that NATO foreign and defense ministers agreed on called for weapons with greater range, accuracy, and survivability than existing land-based theater nuclear missiles. The Army expects Pershing II to provide needed improvements in these areas.

Range

Pershing II will be deployed on the same sites in the Federal Republic of Germany that presently house the U.S. manned Pershing Ia. Pershing II's range is to cover the territory from a point near the forward edge of the battle area to targets out to a distance of ~~Deleted~~. If it achieves this range, NATO would acquire a capability to reach targets over ~~Deleted~~ further than it can with Pershing Ia.

The risk inherent in the program's significant degree of concurrency is best illustrated by the plan for testing the system's range. The first 2 of the 28 scheduled missile flight tests which are to demonstrate Pershing II's range capabilities, will not begin until about April 1982, only weeks before the production decision. At best, assuming that the firings are successful, the decision will consider the results of a very small number of full system flight tests.

Accuracy

The Pershing II incorporates a new reentry vehicle that uses a terminal guidance concept which, the Army expects will provide accuracy of ~~Deleted~~ CEP. This accuracy, coupled with the use of a low-yield warhead, has as one of its objectives, the reduction of collateral damage.

Advanced development testing included five live missile firings. One was aborted due to a component soldering failure. Four of the 5 missiles were delivered to the target at miss distances 659, 118, ~~Deleted~~ The latter two miss distances were achieved when all systems were operating properly. The large miss distances in the other two flights were attributed to equipment malfunctions experienced in flight. For example, the largest, 659 meters, was traced to a software inaccuracy and failure of an antenna gymbal bearing. When correction was attempted, the rotating antenna slowed and then stopped, causing improper radar images to be used in the correlation. Army evaluators believe that the missile's accuracy is exemplified by the two flights that achieved the smallest miss distances. However, the new terminally guided reentry vehicle which is the heart of the Pershing II system, has yet to be observed in the critical operational testing of the hardware.

Survivability

For most weapon systems, prelaunch survivability is heavily dependent on the details of the scenario used. Under any scenario other than a nuclear attack with no warning, the Army expects Pershing II's survivability to be considerable--even with only a modest amount of warning.

The Army believes that at least ~~Deleted~~ hours of warning would be available before a Warsaw Pact attack. Given such warning, Pershing II units plan to deploy to preselected covert field sites and begin a pattern of random movement

among these sites to improve survivability. Although the current Warsaw Pact defenses are estimated by the Army to have ~~Deleted~~

~~Deleted~~ indications are that the Soviet Union may be developing an antitactical ballistic missile capability.

A Pershing survivability evaluation program was conducted in Europe which involved both simulated stages of alert and simulated open hostilities. The data gathered during the program revealed that Pershing II survivability exceeds prelaunch survivability requirements. The Army estimated its survivability to be 10 to 20 percent higher than for Pershing Ia--largely because Pershing II can be employed with greater flexibility.

A possible serious threat to Pershing II survivability is enemy long-range ground/air patrols and satellite reconnaissance. The Army plans to minimize this threat by using night vision devices and ground sensors, and by siting Pershing II units in wooded positions to obscure the view of enemy aircraft and satellites. Other problems noted in the survivability program involve command, control, and communications, but are peculiar to the NATO theater and not just to Pershing II.

ADVANCED DEVELOPMENT TESTING

Advanced development testing was completed in May 1978. The testing was done in two parts, captive flight testing and missile test flights. The captive flight testing consisted of flying a missile sensor correlator attached to the wing of an FJ-4B aircraft. The missile test firings consisted of five live test flights using Pershing Ia propulsion and the Earth penetrator warhead.

The objectives of the over 800 captive test dives made by the aircraft were (1) to verify the sensor correlator's operation before the missile test firings and (2) to obtain data for determining the relationship between captive flights and missile flights.

The Army judged the captive flights to be successful. The tests verified the sensor correlator's ability to operate and, the captive test data obtained was found to be similar to actual correlator performance recorded during missile test flights. On this basis, the Army believes that captive flight test data is a good predictor of missile flight performance.

The major objectives of the five missile test flights were to (1) deliver the terminally guided reentry vehicle to the target, (2) demonstrate reentry vehicle maneuver capability, (3) demonstrate required system accuracy, (4) demonstrate Earth penetrator structural integrity, and (5) verify Earth penetrator performance. This Earth penetrator warhead is no longer being considered as an alternate warhead.

The results of the live missile test flights were considered by the Army as having shown that the five major objectives were achieved. The first two and last two missile flights were successful, while the third missile was destroyed in flight due to a failure in an electrical circuit.

While hardware design changes were not required during the advanced development testing, software changes had to be made to refine the missile's sensor correlator performance. After evaluating the results of this testing, the U.S. Army Materiel Systems Analysis Activity concluded that it warranted the system's entering engineering development.

Army Materiel Systems Analysis Activity evaluation

The Army Materiel Systems Analysis Activity's June 1978 advanced development test report evaluations were developed from sources such as live missile firings, captive testing, ground testing, and simulations. The missile firing test program was conducted at the White Sands Missile Range, New Mexico. The captive testing was also conducted at the White Sands Missile Range, as well as in the Huntsville, Alabama, and the Rome, New York, areas.

The Army Materiel Systems Analysis Activity judged the advanced development test program as generally successful in achieving the test objectives. As a result of the advanced development testing, the Army believes that there are no remaining high risks in the technical development of Pershing II, and that it can adhere to its schedule.

ENGINEERING DEVELOPMENT TESTING

The engineering development program, which is to run for 57 months, began in February 1979. It involves basically four segments of testing:

- A continuation of wind tunnel testing to verify aerodynamic characteristics of the missile.

--A continuation of captive flight testing to verify accuracy and the adequacy of reference data.

--Various component and subsystem testing such as engine testing.

--Twenty-eight live missile firings against targets at short, medium, and long ranges.

The wind tunnel testing is to be completed about May 1981 and the captive flight tests are scheduled to be completed during February 1983. A total of 28 live missile flights are to be conducted from April 1982 to August 1983. In addition, three missiles and accompanying ground support equipment are planned to be used in operational ground testing from February to April 1983. Other testing, such as system environmental testing, is to start in January 1982 and will continue through May 1983. This is to include testing the system against shock and vibration, high and low temperature, snow, ice, rain, and so forth.

Six static firings of the first and second stage propulsion sections were conducted from May through August 1980, and the Army judged them to be satisfactory.

Although the test schedule significantly overlaps the start of production, the Army is optimistic that the Pershing II program will be successful for three reasons. First, all Pershing II subsystems and components will have been tested individually before the first missile flight. Tests include captive flight tests estimated by the Army to be equivalent to about 3,500 missile flights and 37 static motor firing tests to verify propulsion section performance.

Second, the Army believes that advanced development testing has shown a high correlation between missile component testing results and the performance of the missiles in flight. That is, data from captive flight testing of the sensor correlator's accuracy, as compared with advanced development missile flight test data, has proven to be a good predictor of actual missile flight accuracy.

Lastly, the Army believes that the successes in the overall Pershing Ia and Pershing II program to date, coupled with about two decades of Government/contractor experience with Pershing, will further guarantee the success of the Pershing II.

CHAPTER 3

CRITICAL CRUISE MISSILE PROBLEMS MUST BE

RESOLVED BEFORE GLCM CAN BE EFFECTIVELY DEPLOYED

To date there have been no Government flight tests of GLCM. In addition to the testing of GLCM still to come, the Air Force evaluation of the system will incorporate results from the SLCM and ALCM test programs. Most of the major GLCM components are of the same type employed in ALCM and SLCM missiles. Thus, data resulting from testing ALCM and SLCM missiles provides a partial indication of how satisfactorily the GLCM missile is likely to perform. Specifically, because of their similarities, the SLCM and ALCM programs will provide data for the GLCM program in the areas of engine performance, airframe suitability, navigation/guidance, and missile performance. The test results will be accepted as demonstrating GLCM's capabilities.

ALCM testing has identified some critical problems which GLCM would face and require resolution before a GLCM production decision is made. Therefore, a little over 2 years remain before the production decision in which solutions to technical problems already identified and any others that testing might still disclose are found. The GLCM schedule milestones follow.

<u>Milestone</u>	<u>Date</u>
Start operational test and evaluation flights	Dec. 1981
Complete operational testing and evaluation flights	Feb. 1983
Full-production decision	May 1983
Initial operational capability	Dec. 1983

Full system testing of GLCM involving 10 flights will begin in December 1981 and end in February 1983. Two flights will be made by the contractor and eight flights by the Government. This testing is to develop information on the system's ability to meet its technical requirements, and its performance throughout a range of operational environments. The test objectives also include the development of warhead flight test data.

Recent software development difficulties have caused a projected late delivery of the weapon control system software. As a result, the test program was slipped in mid-October 1980 to accommodate late software delivery and to enable testing

of GLCM in the configuration that most closely resembles the operational configuration. The initial operational testing slip of 6 months has evidently caused a 6-month slip in the production decision milestone. However, the initial deployment date remains firm. These slippages could have an impact on resolving GLCM's performance and reliability problems by initial deployment in December 1983. The Departments of Defense and State have reiterated that the United States intends to deploy both GLCM and Pershing II on time and according to the NATO decision. Both departments acknowledge that the missiles initially deployed may require some modification or correction, but consider it of overriding importance for the United States to meet its commitment to have the missiles in place, as scheduled, even if they fall somewhat short of meeting all their performance requirements.

RECENT TEST RESULTS

The Air Force, in a March 1980 report on ALCM's initial operational testing, noted several problems requiring substantial improvements. The test report also noted that adequate evaluation of the results was not possible because of unplanned events, such as 4 missile crashes out of 10 missile launches. Some specific concerns raised by the test report relate to the missile's terrain following capabilities and its accuracy and mission reliability. Because of their similarities, the findings on ALCM would also apply to GLCM.

Terrain following

Although the missile demonstrated an ability to follow the terrain, this, for the most part, was accomplished at flight levels significantly higher than the threshold requirements established by the Air Force. These requirements are important because the lower the missile flies the less it will be exposed to detection by enemy radar systems. However, flying at very low altitudes increases the possibility that the missile will crash into a natural or man-made terrain obstruction.

The tests did, indeed, show that on at least one occasion, when the missile flew below the minimum altitude threshold flight level, it narrowly missed crashing into a hill. The test evaluators concluded that because of this, the operational clearances may have to be set higher than the threshold to avoid a possible missile crash and mission failure. Higher flight levels could lead to cruise missile detection, thereby decreasing GLCM's survivability if it were exposed to enemy threats. Further testing is to determine flight levels for minimizing cruise missile detection and optimizing navigation.

Missile accuracy

ALCM and GLCM will use essentially the same type of guidance system to achieve missile accuracy. Inertial guidance is used to keep the missile on course. Corrections must be made periodically to compensate for navigational drift which occurs during flight. In making these corrections, a radar altimeter is used several times during the flight to determine terrain contour beneath the missile. This contour is correlated with a map stored in the missile's computer, which computes course corrections.

The terrain in the test was not nearly as smooth as much of the terrain over which the missiles will have to fly in case of a European conflict. Rough terrain facilitates the task of orienting the missile's position because of the more easily identifiable land features.

Most of the terrain over which the missiles flew did not resemble the area it will fly over in combat. For example, 86 percent of the maps of the relatively smooth European operational area show terrain roughness of less than 100 feet in height, while only 26 percent of the maps used in the tests showed such little roughness. Also, whereas only 7 percent of the maps covering the operational area show terrain roughness of more than 200 feet in height, almost 50 percent of the test maps were in this category.

The testers also noted that the maps used in the tests were produced from high quality source data that may not be available for operational areas.

Mission reliability

Mission reliability is the probability that the missile which was functional when loaded will complete its mission without a failure critical to the mission. The test report concluded that, on the basis of analytical modeling using limited test data, mission reliability was deficient. The number of critical malfunctions in the system showed significant risk in achieving reliability.

For example, 18 missile flight attempts were made and only 10 were actually launched. Of the 10 launched, 4 crashed. These crashes were attributed to reasons which include problems with the software and engine failure.

The effects on missile reliability and operability after long periods of dormant storage are also of particular concern. A formalized missile storage program and a program

for evaluating the effects of storage on the engine are underway.

MODERNIZING IMPROVEMENTS SOUGHT

The Air Force believes that the GLCM system will provide the necessary improvements sought by the NATO ministers in the three areas of range, accuracy, and survivability.

Range

GLCMs deployed in Europe are to be capable of destroying targets out to a range of 2,500 kilometers. ALCM met these range capabilities in its tests, and because of their similarities, the Air Force states, and we agree, this represents a demonstration of GLCM's capability.

Accuracy

The terminal accuracy of GLCM is to be less than ~~Deleted~~ meters CEP. Recent cruise missile flight testing was inconclusive and did not permit a reliable prediction of the system's terminal CEP. These tests did show GLCM's guidance system, TERCOM, as providing satisfactory enroute accuracy, but over terrain generally rougher than some areas in the Soviet Union where more level terrain may make the guidance system's functioning more difficult.

Survivability

To assure that GLCM is survivable against both conventional and nuclear attacks, a continuum of basing modes varying from fixed base to continuous mobility have been examined. GLCMs are to be based on a main operating base and dispersed to remote sites in times of increased military tension to afford more survivability. The sites are to be located up to ~~Deleted~~ kilometers from the main operating base and each site will accommodate one flight. The sites ~~Deleted~~ ~~Deleted~~ will be ~~Deleted~~ presurveyed during peacetime to avoid compromising of specific positions. Sites earmarked for wartime deployment will not be used for peacetime exercises.

The missiles will be dispersed mounted on a missile transporter-erector-launcher. This vehicle will have a cover for security and for protection against small arms attacks, and will be shielded to reduce infrared radiation. The vehicles will also have a controlled internal environment capable of protecting the operators from the effects of

nuclear, biological, and chemical agents. The vehicle's missile control and launch components will be hardened to some degree against some of the effects of nuclear detonation such as electromagnetic pulses and thermal effects. The vehicle's exterior is to be made to appear, to the maximum extent possible, like any typical military cargo truck-trailer.

Because of the system's remote deployment, it will be sensitive to threats such as long-range reconnaissance patrols, saboteurs, and terrorists. The Air Force plans to use ~~Deleted~~ of 56 troops assigned to each remote site for security purposes.

The Air Force believes that enemy electronic counter-measure equipment could be used to attempt to jam communication links to the remote site. The system's command, control, and communications equipment is being developed to resist such enemy jamming.

CHAPTER 4

CONCLUSIONS, RECOMMENDATION, AND AGENCY COMMENTS

CONCLUSIONS

With a production decision on Pershing II to be made after only 2 of the 28 scheduled live test firings, and with engineering development due to continue almost up to the time deployment is to begin, the Army's schedule for fielding the missile must be viewed as containing a high degree of concurrency. It is not unusual to find some concurrency in major weapon system programs, particularly, where an urgent need to deploy the system is present. However, programs containing as much concurrency as is present in Pershing II have a tendency to falter and generally require more time than is budgeted for proving their performance and reliability before they enter production.

Advanced development testing has demonstrated that it is feasible to achieve the desired accuracy and the resulting minimal collateral damage on impact. However, the critical development and operational testing of the hardware to show that this can be achieved with reasonable consistency, still lies ahead.

While there has been considerable subsystem and component testing, which has not surfaced any significant problems, experience with other weapon systems has shown that integrated testing of the entire system often brings out shortcomings which could not be foreseen when the components were tested by themselves. The limited number of live firings held so far do not appear sufficient to indicate whether the system will be able to meet all its performance objectives before the scheduled initial deployment date.

As with Pershing II, many critical unknown factors about GLCM still exist. The heart of the system, its guidance, must still be demonstrated in a realistic operational environment. The ALCM test results, as they apply to GLCM, are cause for concern. The problems ALCM experienced in maintaining flight levels that would minimize radar detection, problems with its terrain contour mapping guidance, and reliability problems, indicate that considerable progress must still be made in perfecting the cruise missile to achieve the desired capability and reliability.

How survivable GLCM will be also remains a question now, not only because of the need to develop protection against enemy electronic countermeasures, but also because of its

potential vulnerability to covert surveillance while it is being moved from the main operating base to the launching site.

The recent slip in the GLCM test schedule raises further concerns about the program. Although the initial operational testing and production decision have both slipped 6 months, the initial operational capability date remains firm. The severity of the problems, and how quickly they can be resolved, will determine whether the Air Force can begin the initial deployment, scheduled for December 1983, with a fully operational system.

Regardless of these slippages and other uncertainties remaining in the development of both Pershing II and GLCM, the Departments of State and Defense have reiterated that the United States intends to deploy the missiles on time, according to the NATO decision. Both departments acknowledge that missiles initially deployed may require some subsequent modification or correction.

To become involved in modifications after deployment could result in considerable cost. Due to the understandable importance placed on meeting the deployment commitments, there is obviously added pressure to resolve remaining critical performance deficiencies. Hopefully, the confidence of the Department of Defense in the missiles' meeting their performance objectives is well placed. The two programs bear close watching to assure that they perform satisfactorily before beginning deployment.

RECOMMENDATION

Several major tasks remain to be accomplished before an operational Pershing II and GLCM can be deployed according to the planned schedule. Their successful deployment greatly concerns the Congress, particularly, the Committees on Appropriations and Armed Services and the committees which deal with foreign affairs. Therefore, we recommend that

- the Secretaries of State and Defense, include in their annual presentations before the appropriate committees, and more frequently if critical events occur, details on the progress made towards achieving the planned modernizing and deployment of the theater nuclear weapons in the context of the December 12, 1979, decision.

COMMENTS BY THE DEPARTMENTS
OF DEFENSE AND STATE

In discussions with Department of Defense officials associated with the management of the Pershing II and GLCM programs, and with officials of the Department of State's Bureau of Political-Military Affairs, they stated that they agreed with our recommendation. They suggested some changes to an earlier draft of this report for purposes of clarification and technical accuracy and to update the information. These were incorporated, as appropriate.

The Departments of State and Defense both felt our report did not take sufficient account of the progress they believe has been made in both the political and military aspect of the modernization program.

The Department of State believed the report should have emphasized the importance of the unanimous decision by the NATO ministers to modernize the theater nuclear forces after a prolonged effort to secure such agreement. The Department of State believes this decision, and the resolve to press ahead with modernizing, were responsible for bringing the Soviets to the negotiating table at Geneva. State Department officials

Deleted

are satisfied

that good progress is being made in the three countries--the United Kingdom, the Federal Republic of Germany, and Italy--that have already begun to implement the NATO ministerial decision. However, we have not independently confirmed Belgium's commitment.

The Department of Defense does not agree that the degree of concurrency in the Pershing II program is high. Defense officials believe all critical testing will have been completed before the production decision. They have stated that program risks will be further reduced by beginning production at a low level until testing is completed. Defense officials are satisfied that the five missile flights during advanced development testing demonstrated the missile's ability to meet several important performance objectives. Defense officials believe that these tests added to the extensive subsystem and component testing, the captive testing, and the first 2 of the 28 flight tests scheduled during engineering development, will provide a sufficient basis for a production decision.

Defense officials also believe that data provided by large numbers of SLCM flight tests in a configuration closely corresponding to GLCM will be useful in assessing

the latter's capability in all important areas before it is to be deployed. The Department of Defense has stated that GLCM's deployment will be based on an intensive engineering development program which is benefiting from the related ALCM and SLCM programs. Concerning the problem of establishing proper flight levels to minimize detection disclosed in ALCM's testing, Defense officials said GLCM's optimal flight altitude is still to be defined during the continuing development program, and that the relative dearth of rough terrain in the Eurasian land mass which complicates orientation is being addressed in future tests. Defense officials are confident that a sufficient number of both missiles will be available to begin deployment on schedule.

In our opinion, the results of Pershing II's testing to date are encouraging. Our concern with this program is its concurrency, which provides for a production decision to be made after only two flight tests and more than a year before engineering development is completed. In particular, since the Army has seen fit to schedule as many as 28 flight tests, it appears unlikely that the two tests alone will provide sufficient data for determining whether the system should proceed into production.

Regarding the capabilities of the two missiles, we have greater concern about GLCM's technical performance, largely due to problems with the TERCOM guidance system experienced in the ALCM testing and the software problems which have caused a delay in the testing schedule. It will require considerable additional testing before a reliable assessment can be made as to the missile's operational performance potential.

Following the submission of our draft report for comment, State and Defense officials furnished some additional information on recent developments related to the NATO ministerial decision. With the addition of this information, we believe our report now contains a fair presentation of the political status of the theater nuclear modernization program.

General comments by the Departments of Defense and State appear in appendixes I and II, respectively.



RESEARCH AND
ENGINEERING

THE UNDER SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

190 1980

Mr. W. H. Sheley, Jr.
Acting Director, Procurement and
Systems Acquisition Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Sheley:

This is in reply to your letter to the Secretary of Defense of October 29, 1980, regarding your draft report on "Difficulties To Be Overcome if Enhanced Theater Nuclear Forces Are to Meet Their Performance and Deployment Objectives," (GAO Code 951533).

We have reviewed the draft report and note that it does not recommend any changes either in modernization of Theater Nuclear Forces or Arms Control negotiations.

A number of items are brought to your attention:

- o Concerning the Pershing II program, we believe that the major objectives of the advanced development program to demonstrate performance were achieved, that the engineering development program does not exhibit a high degree of concurrency, nor will a decision to produce Pershing II be based on limited test results.

- o As for the Ground Launched Cruise Missiles (GLCM), its deployment will be based on an intensive engineering development program which has benefitted and will continue to benefit from the results of the related ALCM and SLCM programs.

- o Regarding the NATO decision to deploy Pershing II and GLCM, all NATO countries have approved the program and Belgium has recently taken steps to more fully participate in its implementation.

- o The NATO deployment and arms control negotiations decision were closely linked. Discussions on arms control between the United States and the Soviet Union have been started. However, deployment is unlikely to be delayed or cancelled as a result of the negotiations.

- o There are other matters of fact and interpretation in the draft report that need clarification.

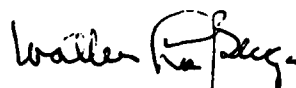
APPENDIX I

APPENDIX I

Attachment A summarizes our comments. Attachment B incorporates our comments in the draft report. These comments have been informally discussed with your staff. We would appreciate your incorporation of them in the final report.

We appreciate the opportunity to comment on the draft report and are willing to further discuss any of the points contained therein with the GAO staff.

Sincerely,



Walter B. LaBerge
Principal Deputy

Attachments

cc: Director, Politico-Military
Affairs, Department of State



DEPARTMENT OF STATE
Comptroller
Washington, D.C. 20520

5 DE 1980

Mr. J. Kenneth Fasick
Director
International Division
U.S. General Accounting Office
Washington, D.C.

Dear Mr. Fasick:

I am replying to your letter of October 29, 1980, which forwarded copies of the draft report: "Difficulties To Be Overcome If Enhanced Theater Nuclear Forces Are To Meet Their Performance And Deployment Objectives".

The enclosed comments on this report were prepared by the Deputy Director of the Bureau of Politico-Military Affairs.

We appreciate having had the opportunity to review and comment on the draft report. If I may be of further assistance, I trust you will let me know.

Sincerely,


Roger B. Feldman

Enclosure:
As stated

State Comments on GAO Draft Report Entitled
"Difficulties to be Overcome if Enhanced
Theater Nuclear Forces are to Meet Their
Performance and Deployment Objectives"

Overall comment: Defense will address particular questions on technical aspects of the two programs. We want to be sure that the systems will perform as specified, and that development and deployment will proceed on schedule. However, the report glosses over the fact that, with the December 12, 1979 decision, the Alliance has accomplished a major political and strategic act. It is essential to emphasize the purposes of this decision:

-- To demonstrate that we will not stand by while the Soviets build up by introducing threatening new LRTNF into their arsenals.

-- To show the Soviets that their country cannot and will not be a sanctuary from which it can use LRTNF to attack Europe without suffering attacks on their own territory.

-- In keeping with these two purposes, to improve NATO's ability to pursue a flexible response strategy with selective nuclear options.

The success of NATO's efforts in LRTNF should therefore be measured by focusing on the political and strategic significance of the December 12, 1979 decision and NATO's determination to implement this decision fully.

GDS 11-1-86

(951533)

